OBJECTIONS TO THE NOMENCLATURE OF THE CELEBRATED...

Robert Hare, Benjamin Silliman

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OBJECTIONS TO THE NOMENCLATURE

OF THE CELEBRATED

BERZELIUS,

WITH

SUGGESTIONS RESPECTING A SUBSTITUTE,

IN

A LETTER TO PROFESSOR SILLIMAN:

First published in 1834, and republished in Silliman's Journal for 1835, Vol. XXVII.

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BIBLIOTECA NAZIONALE CENTRALE FIRENZE

ALSO,

A LETTER

FROM

The distinguished Swedish Chemist abovementioned, in reply; with a concluding Examination of the Suggestions in that Letter, by the Author of the Objections: republished from the Journal of Pharmacy for April, 1837.

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PREFATORY

QUOTATIONS, EXPLANATIONS, AND STATEMENTS.

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(*a*) In his excellent Treatise of Chemistry, Berzelius employs the following language:

> (*b*) "In every science a systematic nomenclature is necessary, and in none more indispensable than in Chemistry. Of this there is ample proof in the confusion which prevailed before the happy idea of a reformation in chemical language was suggested by Guyton de Morveau. The nomenclature which chemists employed subsequently to the year 1780, was the fruit of the labours of the distinguished chemist above named, sustained and directed by Lavoisier, Berthollet, and Fourcroy. The peculiar advantage of the nomenclature thus created, was that a person on hearing the name was advertised of the composition of a compound, and knowing the composition could assign the name.
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> (*c*) A systematic nomenclature is moreover the expression of a theory: so that while the theory assigns the name, the name expresses the theory. It has been objected to this association of nomenclature with theory, ***that it involves the necessity of changing names as theories are changed; while if names be used which are purely technical, they may remain unaltered under any circumstances.*** But these mutations, being generally the consequence of improvements in knowledge, corresponding alterations in nomenclature, far from retarding, actually promote the advance of science. In general, nothing is beneficial which renders any portion of a science stationary. It is necessary that language should keep pace with the progress of science and invention!"

(*d*) The illustrious author might have added another consideration in favour of the preference which he avows for a language founded upon composition, theory, and classification, which is as follows: the names successively given to the same substances, serve to convey historical information respecting the views successively entertained by chemists respecting their ingredients or their nature. Thus, *spirit of salt*, *muriatic acid*, *hydrochloric acid*, and *chlorohydric acid*, are all names for the same compound. Being obtained from salt and sulphuric acid by the distillatory process, before the properties of this compound were understood, it was, like other products of distillation, considered as a *spirit*, and consequently received the first mentioned name. After its *acid* properties had been ascertained, it was called *muriatic acid*, from *muria*, *brine*, or sea water. Subsequently, when this acid was found to be a compound of hydrogen and chlorine, hydrogen being erroneously represented as a co-ordinate with oxygen and a cause of acidity, it was called *hydrochloric acid;* and now, when the other ingredient, chlorine, is made to take precedence, as belonging to that class of bodies which produce both acids and bases, it begins to bear the last mentioned name of *chlorohydric acid*.

(*e*) But let us proceed with the quotation from Berzelius.

(*f*) "The nomenclature of Guyton de Morveau has undergone, from time to time, modifications which have not in every instance been in harmony with its principles. Additions have been made inconsistent with the general system on which it reposes, some authors having adopted names accidentally given to new substances. Hence the nomenclature has been gradually rendered more difficult to comprehend, while it has not been made competent to designate the nature of a multitude of combinations newly discovered, or which have been latterly viewed in a new light. In publishing a new edition of my Treatise on Chemistry, I have deemed it necessary to devise a nomenclature more competent to convey my meaning, and yet sufficiently approximated to that of France, to be understood by those who have been accustomed to the latter."

(*g*) Fully concurring in all the opinions above expressed by Berzelius, I regret that, for reasons which will appear in the subsequent pages, I have not been satisfied with the modifications of the French nomenclature to which that eminent chemist has resorted.

(*h*) Yet agreeably to his opinion, supported, as it has been seen above, upon undeniable grounds, the existing nomenclature "*has been rendered more difficult to comprehend, while it has not been made competent to designate a multitude of combinations newly discovered, or which have been latterly viewed in a new light.*" It may be proper to add that, of the combinations thus alluded to, a large majority have been discovered, or placed in a new point of view, by Berzelius; so that had the names to which he has resorted been as eligible as those of others, I should have considered them as entitled to a preference. The principal portion of the combinations in question, are those which he designates as double salts. But these combinations may be shown to be quite analogous to certain compounds, of sulphur with radicals, which have been by him treated as acids and bases, and distinguished by corresponding appellations. Thus the sulphide of arsenic, and the sulphide of potassium, the one an electro-positive, the other comparatively an electro-negative compound, form the sulpharseniate of potassium. The sulphide of antimony and sulphide of potassium form the sulphantimoniate of potassium. The nomenclature thus employed by Berzelius to distinguish compounds formed by sulphides, has been extended by Thomson to the Berzelian double salts; and in this procedure I had concurred so entirely, that I had actually made up my mind in favour of it, before I was aware of the high authority by which my opinion was sanctioned.

(*i*) I admit that if any nomenclature were *generally* in use, it would be expedient to employ it, however great might be its imperfections, until there should be a concurrent effort for its amendment; since a bad nomenclature generally employed, would be preferable to the best without that advantage; but no chemical nomenclature is thus employed. On this subject, not only do the four great schools of Sweden, Germany, France and Great Britain, differ from each other, but likewise the writers in some schools differ among themselves. Had there been no discordancy in the chemical language of the European schools, I should have preferred to err with the multitude, rather than have resorted in any case to a peculiar arrangement, and corresponding nomenclature. But I have had no alternative, but to pursue a course which seemed erroneous, with some one author of the old world, or to venture to take that which appeared to me to be correct.

(*k*) It could hardly be expected that I should be an imitator of the errors of any one author, and in favour of the other course there were the following additional considerations. Agreeably to the opinions of Berzelius above cited, chemical nomenclature has been judiciously contrived to convey ideas respecting the composition or nature of bodies, and of their theoretic classification. This being admitted, it follows that, while rejecting erroneous classification and theory, it must be inconsistent and disadvantageous to retain the language to which that classification and theory have given birth. In correcting hypothetical errors, it is expedient to employ a reformed arrangement, and a corresponding language. The difficulty thus arising is trifling to a student who gives a reasonable degree of attention, for the following reasons.

(*l*) The words employed explain their own meaning to a student who has once been made acquainted with the principles on which they are founded.

(*m*) Though many words may be employed which differ from those used by some other chemists, the nature and ground of the difference being explained in one instance, the explanation may, by analogy, be extended to a great number of instances; so that the old and new terms may be equally intelligible.

(*n*) If I had taken any one chemist as a guide, I should have preferred to follow Berzelius, as no chemist stands higher in my esteem. I trust that, in the correspondence with Professor Silliman and with him, and in my subjoined re-examination of the topics discussed, it will be found that I have had sufficient grounds for not adopting the Swedish nomenclature; and I hope that the scientific reader may be induced to sanction the nomenclature and arrangement which I have employed, *founded upon premises sanctioned by the practice of all the great schools of the old world.*

(*o*) Before concluding, it ought to be mentioned, that of the nomenclature which I have adopted, a very small portion is my own. The chief innovation lies in the employment of such portions of the nomenclature of each school, or distinguished writer, as appeared to me decidedly preferable.

(*p*) As every reader of these pages may not have a copy of the fourth edition of my Compendium within reach, I will subjoin a table from p. 295 of that work. This table is intended to exemplify the different names given to certain compounds treated as double salts by Berzelius. The Berzelian double chlorides or "*chlorures*" of platinum have been selected as examples.

(*q*) The names agreeably to the old theory of muriatic acid, those employed by Brande and Turner, those employed by Berzelius, and those resorted to by Thomson and myself, are successively given.

Table of the various Names given to the Double Chlorides, exemplified in the case of Platina.

(*r*) *Names according to the Old Theory of the Muriates.*

Potash, Soda, Ammoniacal, or Ammonia,	Muriate of	Platinum.

(*s*) *Names according to Brande and Turner.*

Platino bichloride of	Potassium. Sodium. Ammonium.

(*t*) *Berzelian Names.*

Chlorure platinico,	Potassique. Sodique. Ammonique.

(*u*) *Names according to Thomson, suggested by me before I was aware of their employment by this distinguished Author.*

Chloroplatinate of	Potassium. Sodium. Ammonium.

(*v*) *The Compounds formed with the Protochloride, are by Berzelius designated as follows:*

Chlorure platinoso,	Potassique. Sodique. Ammonique.

(*w*) *And are in the Compendium designated by me,—*

Chloroplatinite of	Potassium. Sodium. Ammonium.

(*x*) To make out the *old* name of any of the compounds of platinum, in which, according to the theory on which they are founded, a different hydracid may be one of the ingredients, substitute for *muriate* the name of the salt formed by the hydracid, whether it be a hydrobromate, hydriodate, hydrofluate, or hydrocyanate.

(*y*) To effect a corresponding change in the names used by Brande, substitute for chloride, the name of the haloid compound in view, whether a bromide, iodide, fluoride, or cyanide.

(*z*) In the Berzelian names, for chlorure, substitute bromure, iodure, fluorure, or cyanure, as the case may require.

(*aa*) By putting for the letters *chloro*, the corresponding letters *bromo*, *iodo*, *fluo*, *cyano*,* the Thomsonian† name of any of the halogene bodies with platinum may be formed.

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* It is only in the case of cyanogen that Thomson's names differ from mine as respects the haloid compounds. I use the term cyanide, agreeably to Henry: he uses cyanodide, and as respects the Berzelian double salts of cyanogen he adheres to the old names.

† As it is convenient to have an epithet to distinguish the different sets of names, I have thought it expedient to distinguish by the name of Thomson those which he was the first to sanction.

(*bb*) As respects changing the radical, the process is the same both in the case of the old, and of the Thomsonian names. We have only to substitute the name of the radical in view for that of platinum.

(*cc*) To change the name to agree with a different radical in the nomenclature of Brande, for the letters in Italics substitute the corresponding letters of the metal in view, as for instance, those in Italics in the following *aur*um, *palladi*um, *osmi*um, *iridi*um, *rhodi*um.

(*dd*) A substitution of the same letters for those in Italics in the Berzelian names; as in *platin*ico, *platin*oso, will make this nomenclature serve for any other radical as well as for platinum.

(*ee*) In obedience to considerations analogous to those abovementioned (*r*), I will subjoin the table (Compendium, 862), of the different nomenclatures of the halohydric acids, erroneously called hydracids. (17, page 7.)

(*ff*) *Names of the halohydric acids, or those formed by the five halogen bodies, chlorine, bromine, iodine, fluorine and cyanogen, with hydrogen, as heretofore given by the French chemists, also by Berzelius, Turner, and others, contrasted with those now employed in my Compendium, agreeably to the practice of Thenard, and with the approbation of Berzelius.*

For hydrochloric	use	chlorohydric.
,, hydrobromic	,,	bromohydric.
,, hydroiodic	,,	iodohydric.
,, hydrofluoric	,,	fluohydric.
,, hydrocyanic	,,	cyanhydric.

(*gg*) *Names of the amphydric acids, or acids formed by the amphygen bodies of Berzelius (excepting oxygen) with hydrogen.*

For hydrosulphuric	use	sulphydric.
,, hydroselenic	,,	selenhydric.
,, hydrotelluric	,,	telluhydric.

OBJECTIONS,

&c. &c.

Objections to the Nomenclature of the celebrated Berzelius, with Suggestions respecting a Substitute deemed to be preferable, published in a Letter addressed to Professor Silliman, and dated in June, 1834.

1. The most striking feature in the nomenclature of Berzelius, is the formation of two classes of bodies; one class called "*halogene*," or salt producing, because they are conceived to produce salts directly; the other called "*amphigene*," or both producing, being productive both of acids and bases, and of course indirectly productive of salts. To render this division eligible, it appears to me that the terms acid, base, and salt, should, in the first place, be strictly defined. Unfortunately there are no terms in use, more broad, vague, and unsettled in their meaning. Agreeably to the common acceptation, chloride of sodium is pre-eminently entitled to be called a salt; since in common parlance, when no distinguishing term is annexed, salt is the name of that chloride. This is quite reasonable, as it is well known that it was from this compound, that the genus received its name. Other substances, having in their obvious qualities some analogy with chloride of sodium, were, at an early period, readily admitted to be species of the same genus; as, for instance, Glauber's salt, Epsom salt, sal ammoniac. Yet founding their pretensions upon similitude in obvious qualities, few of the substances called salts, in the broader sense of the name, could have been admitted into the class. *Insoluble* chlorides have evidently, on the score of properties, as little claim to be considered as salts, as *insoluble* oxides. Luna cornea, plumbum corneum, butter of antimony, and the fuming liquor of Libavius, are the appellations given respectively to the chlorides of silver, lead, antimony, and tin, which are quite as deficient of the saline character as the corresponding compounds of the same metal with oxygen. Fluoride of calcium (fluor spar) is as unlike a salt as lime, the oxide of the same metal. No saline quality can be perceived in the soluble "haloid salts," so called by Berzelius, while free from water; and when a compound of this kind is moistened, even by contact with the tongue, it may be considered as a salt formed of an "hydracid" and an oxybase, produced by a union of the hydrogen of the water with the halogene element, and of the oxygen with the radical. It is admitted by Berzelius, Vol. III., page 330, that it cannot be demonstrated that the elements of the water, and those of an haloid salt, dissolved in that liquid, do not exist in the state of an hydracid and an oxybase, forming a salt by their obvious union.

2. On the other hand, if, instead of qualities, we resort to composition as the criterion of a salt; if, as in some of the most respectable chemical treatises, we assume that the word salt is to be employed only to designate

compounds consisting of a base united with an acid, we exclude from the class chloride of sodium, and all other "haloid salts," and thus overset the basis of the distinction between "*halogene*" and "*amphigene*" elements.

3. Moreover, while thus excluding from the class of salts, substances which the mass of mankind will still consider as belonging to it, we assemble under one name combinations opposite in their properties, and destitute of the qualities usually deemed indispensable to the class. Thus under the definition that every compound of an acid and a base, is a salt, we must attach this name to marble, gypsum, felspar, glass, and porcelain, in common with Epsom salt, Glauber's salt, vitriolated tartar, pearlash, &c. But admitting that these objections are not sufficient to demonstrate the absurdity of defining a salt, as a compound of an acid and a base, of what use could such a definition be, when, as I have premised, it is quite uncertain what is an acid, or what is a base. To the word acid, different meanings have been attached at different periods. The original characteristic sourness, is no longer deemed essential! Nor is the effect upon vegetable colours treated as an indispensable characteristic. And as respects obvious properties, can there be a greater discordancy, than that which exists between sulphuric acid and rock crystal; between vinegar and tannin; or between the volatile, odoriferous, liquid poison, which we call prussic acid, and the inodorous, inert, concrete, material for candles, called margaric acid?

4. While an acid is defined to be a compound capable of forming a salt with a base, a base is defined to be a compound that will form a salt with an acid. Yet a salt is to be recognised as such, by being a compound of the acid and base, of which, as I have stated, it is made an essential mean of recognition.

5. An attempt to reconcile the definitions of acidity given by Berzelius, with the sense in which he uses the word acid, will, in my apprehension, increase the perplexity.

6. It is alleged in his Treatise, p. 1, Vol. II., "*that the name of acid is given to silica, and other feeble acids, because they are susceptible of combining with the oxides of the electropositive metals, that is to say, with salifiable bases, and thus to produce salts, which is precisely the principal character of acids.*" Again, Vol. I., page 308, speaking of the *halogene* elements, he declares that "their combinations with hydrogen, are not only acids, but belong to a series the most puissant that we can employ in Chemistry; and in this respect they rank as equals with the strongest of the acids, into which oxygen enters as a constituent principle." And again, Vol. II., p. 162, when treating of hydracids formed with the halogene class, he alleges "*The former are very powerful acids, truly acids, and perfectly like the oxacids; but they do not combine with salifiable bases; on the contrary, they decompose them, and produce haloid salts.*"

7. In this paragraph, the acids in question are represented as preeminently endowed with the attributes of acidity, while at the same time they are alleged to be destitute of his "*principal character of acids,*" the property of combining with salifiable bases.

8. In page 41 (same volume), treating of the acid consisting of two volumes of oxygen and one of nitrogen, considered by chemists generally as a distinct acid, Berzelius uses the following language. "If I have not coincided in their view, it is because, judging by what we know at present, the acid in question cannot combine with any base, either directly or indi-

rectly, that consequently it does not give salts, and that salifiable bases decompose it always into nitrous acid,* and nitric oxide gas. It is not then a distinct acid, and as such, ought not to be admitted in the nomenclature." Viewing these passages with all that deference which I feel for the productions of the author, I am unable to understand upon what principle the exclusion of nitrous acid from the class of acids, can be rendered consistent with the retention, in that class, of the compounds formed by hydrogen with "*halogene*" elements.

9. Having thus endeavoured to show that the words acid, salt, and base, have not been so defined as to justify their employment as a basis of the Berzelian nomenclature, I will with great deference proceed to state my objections to the superstructure, erected upon this questionable foundation. Consistently with the French nomenclature, the combinations formed by electro-negative principles, with other elements, have been distinguished as *acids*, or characterized by a termination in "*ide*" or in "*ure*," which last monosyllable, when there has been no intention of altering the meaning, has, by the British chemists, been translated into *uret*. The termination in ide, which is common to both languages, is, by Thenard, and other eminent French authors, restricted to the binary compounds of oxygen, which are not acid. Analogous compounds formed with the "*halogene*" elements, chlorine, bromine, fluorine, iodine, cyanogen, &c., have by the same writer been designated by the termination in ure. Thus we have in his work, chlorures, bromures, fluorures, iodures, cyanures. Some of the most eminent chemists in Great Britain have distinguished the elements called halogene, by Berzelius, together with oxygen, as supporters of combustion; and have designated the binary compounds made with them, when not acid, by the same termination as the analogous compounds of oxygen. Accordingly in their writings, instead of the names above mentioned, we have chlorides, bromides, fluorides, iodides. In Henry's Chemistry, cyanure is represented by cyanide; in Thomson's, by cyanodide; and in Brande's and Turner's, by cyanuret.

10. The term *uret*, equivalent as above mentioned to the French *ure*, is restricted by the English chemists to the compounds formed by non-metallic combustibles, either with each other, or with metals. Hence we have in English, sulphurets, phosphurets, carburets, borurets, for sulphures, phosphures, carbures, borures, in French.

11. Berzelius classes as electro-negative, all those substances which are liberated at the positive pole of the voltaic series, either when isolated, or *when in union with oxygen*, while all substances are by him treated as electro-positive which are liberated at the negative pole, either when isolated, or when in union with oxygen. (See Vol. I, page 201.)

12. According to his nomenclature, when both the ingredients in a binary compound belong to the class of bodies, by him designated as electro-negative, the termination in ide, is to be applied to the more electro-negative ingredient; but where one of the ingredients belongs to his list of electro-positive bodies, the termination in ure, (uret, in English) is to be applied to the electro-negative ingredient. As, agreeably to the prevailing nomenclature, which in this respect, the great Swedish chemist has not deemed it expedient to change, the electro-positive compounds of oxygen with radicals, forming electro-positive bases, have each a termination in ide, it seems that consistency requires us, comformably with the English practice, to de-

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* Hyponitrous acid of other chemists.

signate in like manner analogous electrö-positive compounds of the electro-negative elements called by him "*halogene*." But especially it would be inconsistent not to put the same mark upon the compounds of substances which from their analogy with oxygen are placed in the same "*amphigene*" class. If there were insuperable reasons for retaining the term oxide, as a generic name for the electro-positive compounds of oxygen, it seems to me inexpedient not to employ the words sulphide, selenide, and telluride, to designate the electro-positive compounds of sulphur, selenium, and tellurium. And since the three last mentioned elements when united with hydrogen, form electro-negative compounds which act as acids, why not treat them as such, under appellations corresponding with those heretofore used for that purpose.

13. I conceive the following definitions to be justified by the practice of modern chemists in general, as established in the case of oxacids and oxibases. *When two compounds, capable of combining with each other to form a tertium quid, have an ingredient common to both, and one of the compounds prefers the positive, the other the negative pole of the voltaic series, we must deem the former an acid, the latter a base.* And again, all compounds having a sour taste, or which redden litmus, should be deemed acids in obedience to usage.

14. I should think it preferable, if in adopting these definitions, the termination in ide was considered as applicable to all compounds of electro-negative principles with other substances, whether producing electro-negative or electro-positive combinations, and that the terms acid and base, should be considered as severally indicating the subordinate electro-negative and electro-positive compounds. In that case oxybase, chloribase, fluobase, bromibase, iodobase, cyanobase, sulphobase, telluribase, selenibase, would stand in opposition to oxacid, chloracid, fluacid, bromacid, iodacid, cyanacid, sulphacid, selenacid, telluracid; yet for convenience, the generic termination ide might be used without any misunderstanding; and so far, the prevailing practice might remain unchanged. Resort to either appellation would not, agreeable to custom, be necessary in speaking of salts or other compounds analogous to them; since it is deemed sufficient to mention the radical as if it existed in the compound in its metallic state. Ordinarily we say sulphate of lead, not sulphate of the oxide of lead. This last mentioned expression is resorted to, only where great precision is desirable. In such cases, it might be better to say sulphate of the oxybase of lead. So long however as the electro-negative combinations of oxygen are designated as oxacids, and the electro-positive as oxides, it seems to be incorrect not to use analogical terms in the case of analogous compounds, formed by the other pre-eminently electro-negative principles; and assuming the definition above stated, to be justified by modern practice, it follows, that in order to entitle the electro-negative and the electro-positive ingredients of the double salts of Berzelius, to be classed, the latter as bases, and the former as acids, it is not necessary to appeal to the highly interesting and important experiments of Bonsdorff, confirmed in some instances by the testimony of Berzelius himself, proving that the attributes of acidity (as heretofore defined) exist in the one case, and those of alkalinity in the other. My definition is founded upon the conviction that these characteristics have not latterly been deemed necessary to acids, and that in bases, they never were required; having, as respects them, only served as the means of subdivision between alkaline oxides and other bases.

15. Chemistry owes to Berzelius much valuable information respecting

the compounds formed by the substances which he calls "*halogene;*" especially respecting the combinations formed by fluorine, with boron and silicon, and the "*double salts,*" as he considers them, formed by the union of two "*halogene salts,*" &c. While in the highest degree interested in the facts which he has ascertained, it will be inferred from the premises, that I do not perceive that any adequate line of distinction can be drawn in this respect, between the single salts formed by oxacids and oxybases, and the *double* salts formed by his "*halogene*" elements.—Agreeably to the definition which I have ventured to propose, in a combination of this kind, the electro-negative salt would play the part of an acid, while the electro-positive salt would perform that of a base.

16. In common with other eminent chemists, he has distinguished acids in which oxygen is the electro-negative principle, as *oxacids* and those in which hydrogen is a prominent ingredient as *hydracids.* If we look for the word radical, in the table of contents of his invaluable Treatise, we are referred to p. 218, Vol. I, where we find the following definition, "*the combustible body contained in an acid, or in a salifiable base, is called the radical of the acid, or of the base.*—In the second Vol. page 163, he defines hydracids to be "those acids, which contain an electro-negative body, combined with hydrogen;" and in the next page it is stated, that "hydracids are divided into those which have a simple radical, and those which have a compound radical. The second only comprises those formed with cyanogen and sulphocyanogen." Again, in the next paragraph, "no radical is known that gives more than one acid with hydrogen, although sulphur and iodine, are capable of combining with it in many proportions. If at any future day more numerous degrees of acidification with hydrogen should be discovered, the denomination might be founded on the same principles as those of oxacids." Consistently with these quotations, all the electro-negative elements forming acids with hydrogen, are radicals, and of course by his own definition, combustibles; while hydrogen is made to rank with oxygen as an acidifying principle, and consequently is neither a radical nor a combustible. Yet page 189, Vol. II, in explaining the reaction of fluoboric acid with water, in which case, fluorine unites both with hydrogen and boron, it is mentioned as one instance among others in which fluorine combines with *two combustibles.*

17. I am of opinion that the employment of the word hydracid, as coordinate with oxacid, must tend to convey the erroneous idea, with which, in opposition to his own definition, the author seems to have been imbued, that hydrogen in the one class, plays the same part as oxygen in the other. But in reality, the former is eminently a combustible, and of course the radical, by his own definition.

18. Dr. Thomson, in his system, does not recognise any class of acids, under the appellation of hydracids; but, with greater propriety as I conceive, places them under names indicating their electro-negative principles. Thus he arranges them as oxygen acids, chlorine acids, bromine acids, iodine acids, fluorine acids, cyanogen acids, sulphur acids, selenium acids, and tellurium acids.* These appellations might, I think, be advantageously abbreviated into oxacids, chloracids, fluacids, bromacids, iodacids, cyanacids, sulphacids, selenacids, telluracids.

19. As respects the acids individually, I conceive that it would be preferable, if the syllable indicating the more electronegative element had precedency in all, as it has in some cases. The word hydrofluoric does not harmonize with fluoboric, fluosilicic, fluochromic, fluomolybdic, &c. Fluorine being in each compound the electro-negative principle, the syllables indicating its presence, should in each name occupy the same station. These remarks will apply, in the case of acids formed with hydrogen, by all principles which are more electro-negative. Hence we should use the terms chlorohydric, fluohydric, bromohydric, iodohydric, cyanhydric, instead of hydrochloric, hydrofluoric, hydrobromic, hydriodic, hydrocyanic.

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* I had formed my opinions on this subject, before I was aware that Dr. Thomson had resorted to this classification.

20. These opinions, conceived last summer, were published by me in the Journal of Pharmacy for October last. Since then, I find that in the late edition of his Traité, Thenard has actually employed the appellations above recommended.

21. As by the British chemists the objectionable words have not been definitively adopted; the appellations muriatic and prussic being still much employed, it may not be inconvenient to them to introduce those which are recommended by consistency. In accordance with the premises, the acids formed with hydrogen by sulphur, selenium, and tellurium, would be called severally sulphydric, selenhydric, and telluhydric acid. Compounds formed by the union of the acids thus designated, with the bases severally generated by the same electro-negative principles, would be called sulphydrates, selenhydrates, and telluhydrates, which are the names given to these compounds in the Berzelian nomenclature. Influenced by the analogy, a student would expect the electro-negative ingredient of a sulphydrate to be sulphydric acid, not a sulphide. The terminating syllable of this word, by its associations, can only convey the conception of an electro-positive compound.

22. By adhering to the plan of designating each acid by its most electro-negative ingredient, the compounds of hydrogen and silicon, or of hydrogen and boron with fluorine, would appear in a much more consistent dress. In the compound named hydrofluoboric acid, and that named hydrofluosilicic acid by Berzelius, fluorine is represented as acting as a radical with hydrogen, while with boron and silicon it acts as the electro-negative principle. It has been shown that hydrogen, no less than boron and silicon, must be considered as a combustible, and of course a radical. This being admitted, if the compounds in question are really entitled to be considered as distinct acids, one should be named fluohydroboric acid, the other fluohydrosilicic acid. But as I have elsewhere observed, an incapacity to combine with bases, or to react with them without decomposition, is made by Berzelius an adequate reason for expunging the compound formed by one atom of nitrogen with four atoms of oxygen from the list of the acids of nitrogen. I do not, therefore, understand how the compounds referred to, while equally incapable of combination, can be considered by him as acids. At first it struck me that the liquids, consisting of fluohydric acid either with fluoboric acid, or with fluosilicic acid, might be considered as merely united by their common attraction to water, since they separate when this liquid is abstracted by evaporation. Upon reflection, however, I retract that opinion; since it appears to me that if the compounds in question are to be considered as acids, they may be viewed satisfactorily as fluacids with a double radical; but I deem it more consistent to suppose that a fluobase of hydrogen, in the one case, unites with fluoboric acid, in the other with fluosilicic acid; so that fluohydroboric acid might be called fluoborate of the fluobase of hydrogen; or, more briefly, fluoborate of hydrogen; and in like manner fluohydrosilicic acid would be called fluosilicate of the fluobase of hydrogen, or briefly, fluosilicate of hydrogen.

23. There are instances in which compounds, usually called bases, act as acids. Of course it is consistent that compounds, usually called acids, should in some instances act as bases. In this respect a striking analogy may be observed between the union of the oxide of hydrogen (water) with the oxacids and oxybases; and that of fluoride of hydrogen with fluacids and fluobases. According to Berzelius, water, in the first case, acts as a base, in the second as an acid. So I conceive the fluoride of hydrogen acts as a base in the cases above noticed, while it acts as an acid in the compound of hydrogen, fluorine, and potassium, called by Berzelius "*fluorure potassique acide.*" This compound I would call a fluohydrate of the fluobase of potassium, or more briefly fluohydrate of potassium, as we say sulphate of copper, instead of the sulphate of the oxide (or oxybase) of copper. It appears from the inquiries of the author of the nomenclature under consideration, that each of the three acids abovementioned as formed by fluorine, with the three different radicals, hydrogen, boron, and silicon, is capable, with electro-positive metallic fluorides, of forming the compounds treated of by him as double salts. These compounds, to which I have already alluded, might be called fluohydrates, fluoborates, or fluosilicates of the metallic ingredient. As for instance, the compound into which potassium ènters, named by him "*fluorure borico-potassique,*" I would designate as a fluoborate of the fluoride (or fluobase) of potassium, or for the sake of brevity, fluoborate of potassium. "Fluorure silico-potassique" would, by the same rule, be called fluosilicate of potassium.

24. The illustration thus given in the instance of potassium, renders it unnecessary to furnish other examples, as it would only require that the name of any other metal should be substituted for that of potassium, in order to modify these appellations, so as to suit every case.

25. Pursuant to my fundamental definition, ferroprussiate of potash, cyanure ferroso potassique in the Berzelian nomenclature, should be considered as a compound of cyanoferric acid, and a cyanide or cyanobase of potassium, and would of consequence be a cyanoferrate of potassium. But as there are two salts of iron, one having a larger proportion of cyanogen than the other, as the names cyanure ferroso potassique, and cyanure ferrico potassique indicate, we should have both a cyanoferrite and a cyanoferrate of potassium; and of course cyanoferrous and cyanoferric acid for their respective electro-negative ingredients. "Cyanure ferrique acide" would be exchanged for cyanoferrate of hydrogen, being a case analogous to that of the "fluorure potassique acide" above considered and provided for.

26. If I am justified in my impression above stated, water, and the compound formed by fluorine with hydrogen ("hydrofluoric acid" or fluohydric acid as I prefer to call it) should be severally designated as acids when they act as acids; as bases, when they act as bases. In other cases the one might be designated as an oxide, the other as a fluoride, of hydrogen. In the case of a compound so well known as water, I would adhere to the common name, resorting to the scientific names only as definitions. Thus water would be defined as an oxide of hydrogen, which in some combinations, acts as an oxybase of hydrogen, in others as hydric acid, or the oxacid of hydrogen.*

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* The use which I have made of the terminations in ide, in fluoride of hydrogen, or oxide of hydrogen, to signify a compound of hydrogen with fluorine, or oxygen generally, without conveying the idea of its being either a base or an acid, illustrates the advantage which would result from the use of that termination in that broad sense.

27. After designating as metalloids all non-metallic bodies, Berzelius alleges (page 203, vol. 1st,) that they are divided into oxygen, and bodies which are *combustible*, or *susceptible of combining with oxygen;* in which process the greater part display the ordinary phenomena of combustion, or, in other words, of fire. Agreeably to this classification, susceptibility of union with oxygen and combustibility are confounded; to which I object, because oxidizement frequently ensues without combustion, and combustion occurs often without oxidizement.

28. Speaking of chlorine, (Treatise, p. 276, Vol. I.) it is alleged that it supports the combustion of a great number of bodies, of which a majority ignite in it at ordinary temperatures. If oxidizement be identical with combustion, how can this word be employed with propriety in the case thus quoted, where oxygen is not present? If combustion in the case of chlorine is applied only to those instances in which reaction with other bodies is attended by the phenomena of fire, why is not the term equally restricted in its application in the case of oxygen?

29. Oxygen differs so far from the substances usually called combustibles, that they will produce fire with oxygen, and with but few, if any other substances; while oxygen will produce fire with many substances. But this characteristic of producing fire with many substances, applies to chlorine, and as chlorine does not produce fire with oxygen, it is devoid of the only characteristic which should entitle it to be treated as a combustible, if combustibility and susceptibility of union with oxygen be identical.

30. Hence, if it be deemed proper in the case of oxygen to place the bodies with which it enters into combustion in one class, designated as combustibles, while oxygen is distinguished as the common "*comburant*" of them all, there is equal reason for placing chlorine in a like predicament. The impropriety of designating the substances comprised in his halogene and amphigene classes, with the exception of oxygen, as combustibles, upon the basis of their susceptibility of oxidizement, must be evident from the fact, that fluorine is not oxidizable, while it is so perfectly analogous to the others, especially chlorine, in its properties, that it would be disadvantageous to class it apart.

31. Berzelius objects to the use of the word "*comburant*," (equivalent to the English word supporter) upon the ground that the same substance may alternately be a supporter and a combustible. I should, however, go farther, and likewise object to the use of both words, as tending to convey the erroneous impression, that in combustion, one of the ponderable agents concerned, performs a part more active than the other; whereas, in all such cases, the reaction must evidently be reciprocal and equal. I have repeatedly shown to my pupils, that a jet of oxygen burns in an atmosphere of hydrogen, as well as a jet of hydrogen similarly situated in oxygen.

32. I would recommend that all the bodies comprised in the halogene and amphigene classes of Berzelius, should be placed under one head, and called the basacigen class, thus indicating their common and distinguishing quality, agreeably to the premises, of producing both acids and bases: the electro-negative compounds of these substances to be called acids, their electro-positive compounds, bases, as already suggested.[*]

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[*] Since the preceding letter was ready for the press, the following remark of Berzelius attracted my attention, as sanctioning indirectly the definition which I have proposed, paragraph 13.

Treatise, Vol. 3, page 323, he alleges—"It follows from this that the property of playing the part of an acid, is attached neither to the substance, nor to the manner in which the combination takes place. *It only indicates a state contrary to the property of being a base.*"

Letter from J. J. Berzelius of Stockholm, to R. Hare, M.D., Professor of Chemistry in the University of Pennsylvania, acknowledging the receipt of a Communication respecting Nomenclature, and replying thereto.

Stockholm, September 23d, **1834.**

33. Sir—I am very much obliged to you for the remarks, which, under the date of June 21st, you had the friendship to communicate to me, respecting the nomenclature which I have employed in my Treatise of Chemistry.

34. I perceive that having contemplated chemical phenomena under different points of view, we differ as to the nomenclature which is the most appropriate for their description. I consider the combinations of metals with chlorine, bromine, &c., as salts; whilst you, in accordance with Mr. De Bonsdorff, consider them as bases and acids, capable of forming salts by their union.

35. If it were expedient that chemical classification should be dependent on the number of simple bodies which enter into each combination, this idea of Mr. De Bonsdorff would without doubt be preferable; but if attention be due to the chemical properties which characterize combinations, we cannot adhere to an arrangement founded on the number of the elements. Yet so essential is it in chemistry to have reference to properties, that a system of chemistry in which common and analogous properties should not affect the arrangement, would present a mass of facts so chaotic, that no memory would be competent to retain them. In a system thus strictly conformable to the ideas of Mr. De Bonsdorff, cyanogen, though in its properties resembling chlorine or bromine, which are simple bodies, ought to be considered also as a base, or as an acid, having azote for its radical—I am persuaded you would not approve of extending the system of De Bonsdorff so far; but if it be correct, it would be inconsistent not to make this extension.

36. But let us return to the combinations of the metals with chlorine, fluorine, &c., and make, in imagination, the following experiment. Let us take two portions of caustic potash, a base in which the *basic* characters are more striking than in any other. To one, let us add a sufficiency of sulphuric acid to extinguish entirely its *basic* property; we shall then have a neutral body of a saline taste. You will admit it to be a salt. Now let us add to the other portion, hydrofluoric acid. At a certain point the *basic* properties of the potash will disappear, and we shall have a resulting compound quite as neutral as the sulphate of potash, endowed with a saline taste entirely analogous to that of the sulphate. The basic properties of the potash are destroyed by the hydrofluoric acid, as well as by the sulphuric acid. But you will allege the resulting combination is not a salt, but a base which has exchanged one basifier (oxygen) for another basifier (fluorine). In proof you may add as much more hydrofluoric acid, which combining with the new base will form with it a crystallized salt. But this salt is not neutral, it has almost the same acidity of taste as the hydrofluoric acid employed. The new base does not destroy then the acid reaction.

37. Let us make a further addition of sulphuric acid to the sulphate of potash. A salt equally acid will result, in which the sulphate of potash acts the same basic part towards the sulphuric acid, as the fluoride of potassium towards the hydrofluoric acid. Should it be desired to extend the comparison further, it will be found that for each less electro-positive fluoride, sus-

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ceptible of combination with the potassic fluoride, there will be, with but very few exceptions, a corresponding sulphate, susceptible of combination with the sulphate of potash. The analogy is then complete, it exists not only in the perfect neutrality of the two potassic salts, in their saline taste, but also in their manner of forming combinations with other bodies; notwithstanding one of them, the sulphate, contains one element more than the other. If, instead of potash, potassium were employed to saturate our two acids, the analogy of the operation in both cases, would be still more complete. The same quantity of metal would displace equal volumes of hydrogen. When the visible results of our experiments are so perfectly analogous, it is to be presumed that the invisible process which we do not see, may also be perfectly analogous, and that if facts exactly alike are explained differently, there must be a defect in the explanation. If, for instance, the true electro-chemical composition of the sulphate of potash should not be $KO+SO^3$, as is generally supposed, but $K+SO^4$,[*] and it appears very natural that atoms, so eminently electro-negative as sulphur and oxygen, should be associated, we have in the salt in question, potassium combined with a compound body, which, like cyanogen in $K+C^2 N$,[†] imitates simple halogen bodies, and gives a salt with potassium and other metals. The hydrated oxacids, agreeably to this view, would be then hydracids of a compound halogen body, from which metals may displace hydrogen, as in the hydracids of simple halogen bodies. Thus we know that SO^3, that is to say, anhydrous sulphuric acid, is a body whose properties, as respects acidity, differ from those which we should expect in the active principle of hydrous sulphuric acid.

38. The difference between the oxisalts, and the halosalts is very easily illustrated by formulæ. In KFF (fluoride of potassium), there is but one single line of substitution, that is to say, that of K|FF; whilst in KOOOOS (sulphate of potash) there are two, K|OOOOS and KO|OOOS of which we use the first in replacing one metal by another, for instance, copper by iron; and the second in replacing one oxide by another.

39. I do not know what value you may attach to this development of the constitution of the oxysalts (which applies equally to the sulphosalts and others): but as to myself, I have a thorough conviction, that there is therein, something more than a vague speculation; since it unfolds to us an internal analogy in phenomena, which, agreeably to the perception of our senses, are externally analogous. If these phenomena are to be considered agreeably to the ideas of Mr. De Bonsdorff, how does it happen that sulphur, phosphorus, arsenic, and other radicals of the strongest oxacids, when united with chlorine, bromine, iodine, &c., do not combine with the chlorides,[‡] bromides &c., of the metals of the alkalies and of the earths; whilst the chloride and bromide of potassium combine easily with those of magnesium, iron and manganese? Should then the chloride of magnesium, or that of manganese, be a stronger acid than the chloride of sulphur, or chloride of phosphorus? How is it consistent with these ideas that we can

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[*] In the Berzelian symbols, K stands for kalium, or potassium, S for sulphur, O for oxygen, and O^3 for three atoms of oxygen, O^4 for four atoms of oxygen.

[†] That is to say, if the salt called sulphate of potash, be considered as a compound of potassium, and a quadroxide of sulphur, instead of being viewed as a protoxide of potassium, or potash, and tritoxide of sulphur, or sulphuric acid.

This is the formula for cyanide of potassium, consisting of potassium, K, and cyanogen, or two atoms carbon and one of nitrogen, $C^2 N$.

[‡] I have translated chlorure, fluorure, bromure, by chloride, fluoride, and bromide, agreeably to the practice of the British chemists.

obtain crystallized salts, as well with as without water of combination, composed of chloride of calcium and of oxalate, or of acetate of lime? Should the oxysalt be here the acid, or the base? I have now displayed to you the considerations which have guided me, and which I think are not destitute of foundation.

40. I cheerfully admit that it would be preferable to employ the word chlorohydric instead of hydrochloric. My motive for retaining this last is, that I have ventured to propose a new nomenclature in a language foreign to me, in which it was inexpedient to make changes which could be avoided without inconvenience. I also agree with you, that we ought not to use combustible and oxidable, as having the same meaning. I have deserved your strictures for this inconsistency in my language; but I must suggest as an apology, that the two words were formerly used as synonymous, and that the work, in which you have recently noticed this oversight, was first published in 1806, having been from time to time, remoulded for new editions, without its having been possible to eradicate all that has not kept pace with the progress of science.

41. Accept the assurance of my perfect esteem, and of the sentiments of sincere friendship with which I have the honour to be,

Yours, &c.

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An Examination of the Suggestions in the preceding Letter of Berzelius, and how far the Objections made to his Nomenclature, are therein answered. By Robert Hare, M. D., Professor of Chemistry in the University of Pennsylvania.

42. So far as my strictures were founded on the alleged difficulty of defining the terms acid, salt, and base, in any mode consistent with his classification, they are not met by any facts or reasoning in the much esteemed letter of my illustrious correspondent. The impracticability of defining a salt, he does not deny; and with great candour he admits that, in his definition of acidity, he has not been consistent. He concedes that it would be preferable to give the syllable, indicating the electro-negative ingredient, the precedence, as nothing but unwillingness to innovate, prevented him from pursuing that course.

43. He acknowledges that as combustion, in many instances, takes place without the presence of oxygen, the application of the word combustible, should not be confined to bodies which are susceptible of oxidizement.

My definition of acidity was as follows:—

44. "*When, of two substances capable of combining with each other so as to form a tertium quid,*[*] *and having an ingredient common to them both, one prefers the positive, the other the negative pole of the Voltaic series, we must deem the former an acid, and the latter a base. Also all substances having a sour taste, or which redden litmus, must be deemed acids, agreeably to usage.*" This definition I would now amend by leaving out the last sentence, and substituting therefor, the following: ***Also when any substance is capable of forming a tertium quid with any acid or base***

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[*] This term *tertium quid* has been used by chemists, more formerly than of late, to designate a compound resulting from the union of two bodies, but in its properties resembling neither.

agreeably to the preceding definition, it must be considered as an acid in the one case, a base in the other. The definition, thus amended, takes in the organic acids and bases. In the form in which it was at first proposed, it has not been alleged defective by Berzelius; but he has striven to show an incongruity in the attributes of his double salts, when contrasted with those resulting from the union of some of the acids and bases of his amphigen class; which incongruity is, in his opinion, a sufficient reason for not considering them as *single* salts, and their ingredients as acids and bases, agreeably to the opinions of De Bonsdorff and myself.

45. Berzelius errs in confounding my opinions with those of De Bonsdorff. However I may have admired the sagacity with which that chemist investigated the pretensions of some haloid salts to certain attributes of acidity or alkalinity; in my letter on the Berzelian nomenclature, I signified my unwillingness to rest my opinions upon a basis so narrow, as that which he had endeavoured to establish. I stated that I did not deem it necessary to appeal to his excellent observations, proving certain attributes of acidity to exist in one case, those of alkalinity in the other. I alleged my definition to be founded on the conviction that the property of affecting vegetable colours, on which that sagacious chemist lays so much stress, has not, latterly, been deemed necessary in acids; and that in bases it never was required. As respects them, it only served as the means of subdivision between alkaline oxides and other oxybases.

46. I am at a loss to discover in what part of my letter there was any language which could convey the erroneous impression, that, in defining acids and bases I proposed to overlook properties, and to be regulated by attention to the number of atoms in a compound. Certainly nothing was more foreign to my thoughts.

47. It is assumed by Berzelius that the saturation of the fluobase of potassium by fluohydric acid, cannot be considered as analogous to the saturation of the oxybase of potassium by sulphuric acid; because the resulting compound is to the taste, in one case neutral, in the other sour. In reply I suggested, that if the salidity of the biborates and bicarbonates was not to be questioned on account of their alkaline taste, nor that of the protochloride of tin on account of its sourness, it was not consistent that the pretensions to salidity of the fluohydrate of the fluobase of potassium should be denied on account of its sour taste. I will now add, that if the fluosilicate of potassium be a double salt, the fluoride of silicon one of its two constituents must be a simple salt, and yet it is sour. If a simple salt may be sour, why may not a double salt have this attribute; and how in fact can its presence be inconsistent with salidity? Is not the absence of this characteristic in silica and tannin, and many other acids, as much against their claims to acidity, as its presence in other compounds is an objection to their association with saline bodies. It is considered by Berzelius an objection to the views which I have espoused, that the halogen bodies, while forming acids with various metallic radicals which oxygen does not acidify, do not form acids with sulphur, phosphorus and arsenic, which oxygen does acidify; yet what is there in this, more difficult to reconcile with the established results of chemical combinations, than in the fact that oxygen forms with sulphur, phosphorus, and arsenic, strong acids, with hydrogen, water; while with hydrogen the halogen bodies all form compounds which Berzelius describes as having the highest pretensions to acidity. The highly active acid properties of the fluorides of boron and silicon, would lead us to expect similar compounds to be formed by the same radicals, with the other halogen

bodies, contrary to experience. Chemistry makes us acquainted with many similar discordances. How is it that oxygen forms aëriform compounds with an extremely fixed body in the instance of carbon; while in that of phosphorus or arsenic, both volatilizable, it forms acids which are comparatively insusceptible of volatilization? Wherefore does not hydrogen produce an acid with phosphorus and arsenic, as well as with sulphur?

48. According to Berzelius, all the halogen bodies produce with hydrogen combinations which are as highly endowed with the attributes of acidity, as the strongest acids into which oxygen enters as a constituent. It is conceded in his letter that his language respecting these combinations cannot be reconciled with his declaration in one place that they do not combine with oxybases, and in another that a body which cannot so combine is not an acid. It strikes me, that the only way in which the admitted inconsistency of his description of these bodies, with his definition of acidity, can be avoided, is by assuming that they combine as acids with haloid bases, although decomposed by oxybases.

49. I will now proceed to comment on a new subject for consideration, presented in Berzelius's letter in reply to mine.

50. It must be evident that every oxysalt, composed of an oxacid and an oxybase, must consist of an atom of each radical, and as many atoms of oxygen as exist both in the acid and in the base. Thus sulphate of potash consists of an atom of potassium, an atom of sulphur and four atoms of oxygen, and may be represented either by $SOOO|KO$ or $SOOOOK$.

51. Berzelius in his letter repeats an ingenious suggestion previously advanced in his treatise, that $SOOOO$, (sulphur with four atoms of oxygen,) may act as a compound halogen body like cyanogen, and thus form a salt by union with an atom of any radical. He conceives that the apparent want of analogy, which induced him to separate into two classes, the amphigen and halogen bodies, disappears under this view of the phenomena; and that his amphide salts might be considered as constituted of a compound halogen body and an elementary radical. But however we may admire the ingenuity of these suggestions, ere, in obedience to them, we extend the limits of the halogen class, I would request that the word salt should be defined, and that it be shown that consistently with any definition which can be devised, there is any class of bodies in nature which merit the appellation of salt-producers. Before enlarging the superstructure, let it be shown that the basement has been well grounded.

52. Berzelius lays some stress on the community of effect, in the evolution of hydrogen, both by acids formed by hydrogen with halogen bodies, and by diluted hydrous sulphuric acid, as evincing a similitude of composition justifying the suggestion above quoted from him. But I conceive that this common result is better explained by ascribing it to the tendency of radicals to displace each other from combination, whether existing in a simple or a complicated compound. If water exists as a base in hydrous sulphuric acid, as I have elsewhere suggested, we may consider this hydrous acid as a sulphate of the oxybase of hydrogen; and that when it reacts with zinc or iron, the proneness of hydrogen to the aëriform state enables either metal to take its place, agreeably to the established laws of affinity.

53. It may be proper, before concluding, to explain more particularly the nomenclature which I have adopted.

54. The amphigen, and halogen bodies of Berzelius, as they produce acids and bases according to my definition, are all classed as basacigen bo-

dies. Of course oxygen, chlorine, bromine, iodine, fluorine, cyanogen, sulphur, selenium, and tellurium, are included in this class.

55. The general designation of a binary compound of a basacigen body, is the termination in *ide;* the special, the termination in ***acid***, when the compound acts as an acid, in ***base***, when it acts as a base.

56. Hence an oxide, may be an oxacid, or an oxybase;

a chloride,	a chloracid,	or a chloribase;
a bromide,	a bromacid,	or a bromibase;
an iodide,	an iodacid,	or an iodobase;
a cyanide,	a cyanacid,	or a cyanobase;
a sulphide,	a sulphacid,	or a sulphobase;
a selenide,	a selenacid,	or a selenibase;
a telluride,	a telluracid,	or a telluribase.

57. Compounds which consist of radicals only, are distinguished by the term *uret* equivalent to the French ***ure***. Hence ***carburet***, ***phosphuret***, ***boruret***, ***silicuret***.

58. Of any two binary compounds containing each the same basacigen body and forming one compound, the more electro-negative is an acid, the other a base. Hence all the electro-negative haloid compounds in the Berzelian double salts, are acids, and the electro-positive, bases. Where there are two such compounds, one containing one basacigen atom, the other two atoms or one and a half, the former has a termination in ***ous***, the latter in ***ic***. As for instance the ***chlorure platinoso-potassique*** of Berzelius is a compound of ***chloroplatinous acid***, and the ***chlorobase of potassium***, and is the ***chloroplatinite of potassium***. The ***chlorure platinico-potassique*** of the same author, is the ***chloroplatinate of potassium***.[*]

59. By analogy the intelligent reader may easily make these examples a clue to designate any other of the double salts of Berzelius so as to accord with the plan in question. He may have a ***bromoplatinate*** or ***bromoplatinite***, a ***iodoplatinate*** or ***iodoplatinite***, a ***fluoplatinate***, *&c.*; or changing the radical a ***chloroaurate*** or ***chloroaurite***, a ***bromoaurate*** or ***bromoaurite*** *&c.*

60. The terms amphigen and halogen being employed both from expediency, and in honour of their author, we may use his terms haloid and amphide, to distinguish the acids or bases severally formed by these classes, the abreviations ***halo*** and ***amph***, being employed in composition. Thus I designate the acids formed by the halogen bodies with hydrogen, as halohydric acids; those formed with that radical by the amphigen bodies, as amphydric acids. As the same radical will in other cases be found to form acids with several of the halogen bodies, platinum for instance, the acids thus produced, may be called haloplatinic acids; or if gold were the radical, they would be called haloauric acids. These examples will suggest to the chemical reader a series of names, as for instance ***haloargentic***, ***halocupric***, ***halostannic***, ***halopalladic***.

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[*] In designating salts of the metals proper, as for instance, the *nitrate of mercury*, the idea of the oxidizement of the metal is always understood, although usually not expressed. In the instance above cited, we actually mean the *nitrate* of the *oxide*, or *oxybase* of mercury. By analogy, I here use the term *chloroplatinate of potassium* for *chloroplatinate* of the *chlorobase of potassium*. It is, in fact, well known to chemists, that acids do not unite directly with metals. The only alleged exception to this rule, of which I have any knowledge, is that of tellurium and sulphuric acid. It is inferred, therefore, that when an acid is combined with a metal, the latter must exist in the state of a base formed with the basacigen body which enters into the composition of the acid.

61. I consider Prussian blue as a cyanoferrite of the cyanobase of iron, or briefly a cyanoferrite of iron. The diversity of properties which enables two cyanides of iron to exist in combination in this cyanoferrite, one as an acid, the other as a base, is one among many other instances in which compounds constituted of the same elements in the same ratio, have different properties, and are said in consequence to be ***isomeric***, or to afford cases of ***isomerism.***

62. The salt designated by Berzelius as the "*cyanure ferroso-potassique,*" is the well known test for iron heretofore called ferroprussiate of potassa, under the idea that it consisted of prussic acid, iron, and potassa. As the prussic acid was viewed at the same time as a compound of hydrogen and cyanogen, the ferroprussic acid was considered as a compound of cyanogen, hydrogen, and iron. According to Berzelius, the supposed *ferroprussiate* is a compound of a "*protocyanure*" of iron, and a "*cyanure* of *potassium*;" each being a simple haloid salt, and the aggregate a double "*cyanure.*" Agreeably to my nomenclature, the "*protocyanure*" of iron is considered as cyanoferrous acid, and the "*cyanure*" of potassium as a cyanobase; the aggregate being the cyanoferrite of the cyanobase of potassium, but designated briefly as the cyanoferrite of potassium.

63. I infer that the "*ferroprussic*" acid is analogous in constitution to the triple compound of fluorine, silicon and hydrogen, improperly called hydrofluosilicic acid; and that, consistently with the hypothetical views under which the latter received its name, the former should be called hydrocyanoferric acid. Even admitting the correctness of the hypothetical impression, to which I have alluded, agreeably to which such compounds are acids with a double radical, I urged that the appellations of such compounds should be so altered as to give precedency to the electro-negative ingredient. Hence the one would be called cyanohydroferric acid; and the other, fluohydrosilicic acid. But in my letter to Silliman, already cited, I advanced a new hypothesis respecting the constitution of the fluohydrosilicic, and fluohydroboric acids. I suggested that they should be considered as compounds in which the fluorides of silicon or boron acted as acids, the fluoride of hydrogen as a base. Consistently with that doctrine, I would consider the ***protocyanide*** (or "*cyanure*") of iron in the alleged ***ferroprussic acid***, as acting as ***cyanoferrous acid***, the ***cyanide*** of ***hydrogen*** (***prussic acid***) as a ***cyanobase***, forming, by their union, a cyanoferrite of hydrogen.

64. As compounds, consisting of a basacigen body, hydrogen and a radical, do not, when presented to bases, enter into combination; but are, on the contrary, decomposed so as to allow another radical to take place of their hydrogen, it is inconsistent with chemical law, as stated by Berzelius,[*] or my definition of acidity (**13**), to designate them as acids.

65. I have called the electro-negative "*protocyanure*" of iron of Berzelius, cyanofer*rous* acid, because there is a "sesquicyanure" in the *cyanure ferrico-potassique*" of that author, which, by analogy with the nomenclature of the oxacids, is entitled to the appellation of cyanoferric acid.

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[*] **Traité, page 41, vol. ii.**